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FLY'S EYE LENS AND FABRICATION PROCESS

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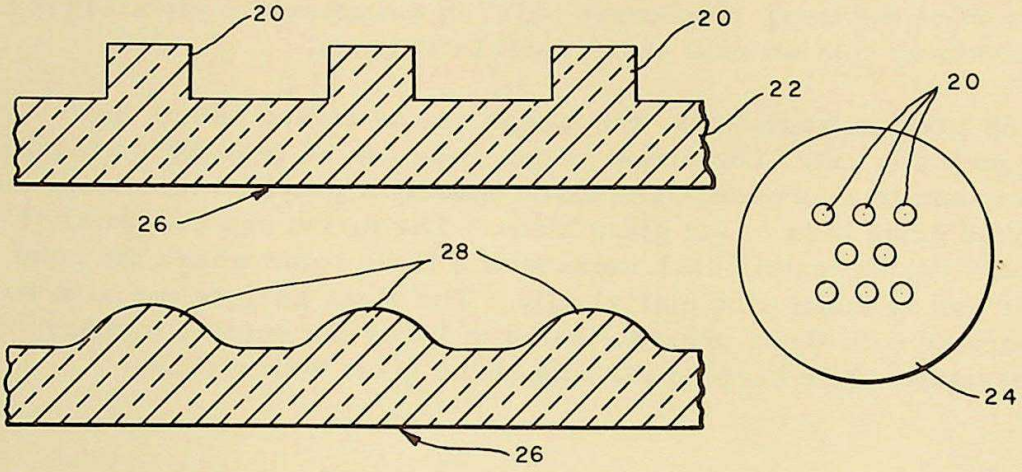

This fly's eye lens has reduced wear from scratching and improved dimensional stability. The lens is amenable to the fabrication of photographic masks for the purposes described in the IBM Journal of Research and Development, April 1963, pages 146 through 150.

Cylindrical mesas 20 are ultrasonically cut on one side of a polished glass disk 22 having a planar surface 26. Mesas 20 appear as an array in a lens element 24. Disk 22 is placed on a sooted quartz slab, not shown. The lens is fired in a furnace to fuse down mesas 20 into spherical lens elements 28. During fusion, the glass becomes viscous and surface tension forces produce the elements 28.

For good optical images, the radius of curvature elements must be constant over the useful aperture region of the individual lens elements. Also, the radius of curvature of each lens element must be the same. Finally, the fusion must be terminated at the proper point to produce the desired radius of curvature. The time/temperature fusion is regulated to give the desired radius. When the lens 24 is furnace fused, the starting thickness of wafer 22 is slightly larger than that of the desired lens. After fusion, surface 26 is polished down so that the images are coincident with the back surface.

As one example, a pyrex glass blank 80 mils thick and 1.75" in diameter is cut with 1450 mesas on .030" centers. Glasses other than pyrex can also be employed. The mesas are about .016" by .008" in diameter and height, respectively. The fusion is done by heating the glass blank in nitrogen for about two minutes at 1080°C. The final radius of each mesa is approximately .024". The blank is polished to a final thickness of .071" after fusion. Aluminum is evaporated onto the front of the lens. Apertures .012" in diameter are etched in the aluminum by conventional photoresist techniques.

As process variations, the mesas can be etched rather than ultrasonically cut. The fusion of the mesa can be done with a torch rather than in a furnace. The torch operation prevents distorting the polished plane back of the glass blank. The fusion can also be done by individually heating each mesa with a laser beam where the input power can be controlled electrically. The glass surface can also be evaporated with B_2O_3 prior to fusion to lower the surface melting temperature while keeping the bulk of the glass disk rigid.